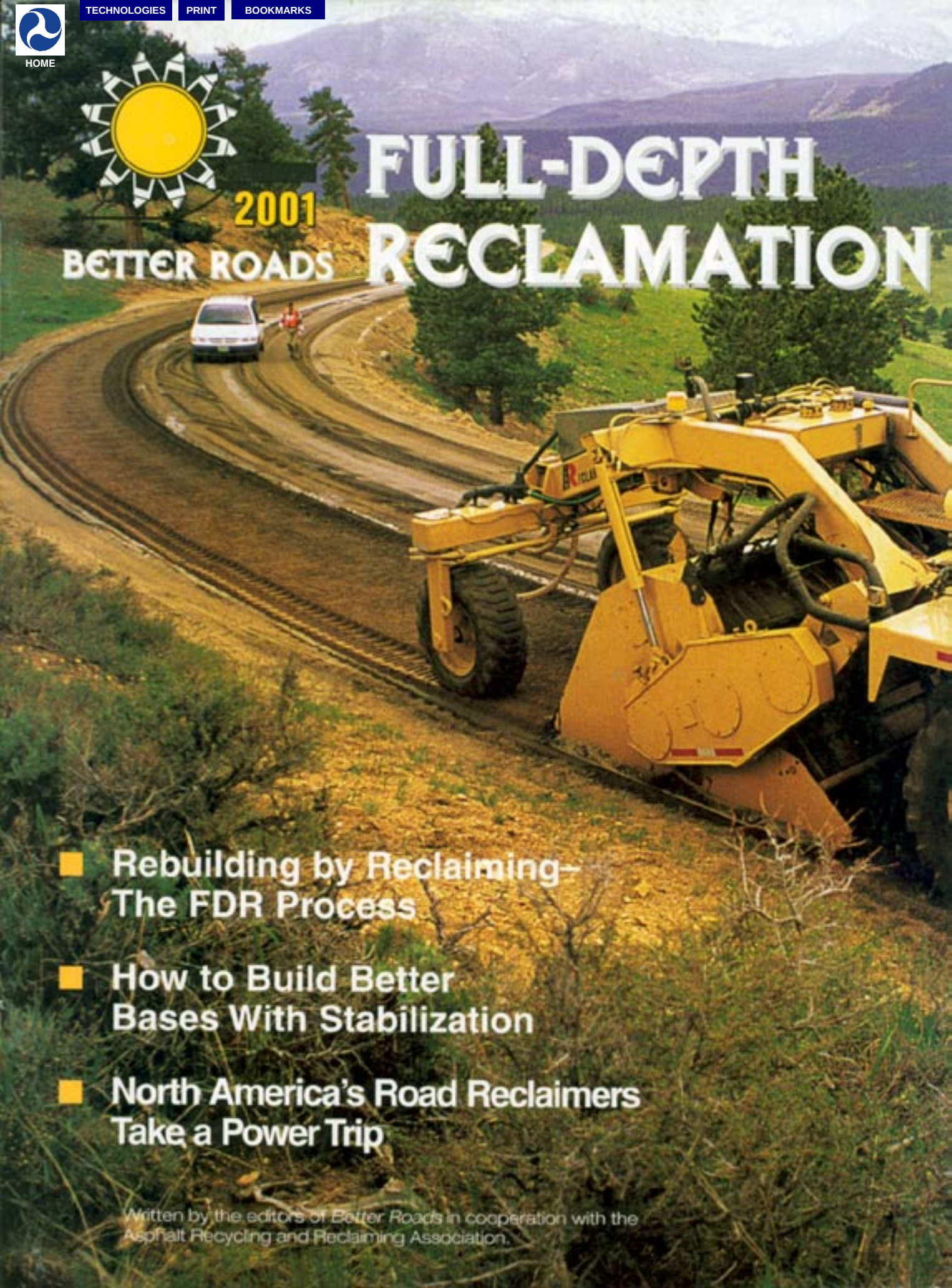

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FULL-DEPTH RECLAMATION

- Rebuilding by Reclaiming–The FDR Process
- How to Build Better Bases With Stabilization
- North America's Road Reclaimers Take a Power Trip

Written by the editors of *Better Roads* in cooperation with the Asphalt Recycling and Reclaiming Association.

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What is Full-Depth Reclamation?

Between mill-and-fill and total reconstruction, there's an economical, long-life alternative that's gaining popularity in North America

Everyone from highway engineers to frustrated motorists has fantasized about a machine that would move steadily down a road, gobbling up bad pavement in front and leaving a trail of perfect pavement in the rear. No more construction backups. No more breathlessly expensive rebuilds. No more pockmarked, rutted roads waiting to break axles and bend wheels.

Although pavement recycling technology has not yet evolved to fulfill that fantasy, the industry is getting closer.

Cold planing, cold-in-place recycling, and hot-in-place recycling are accepted, widely used techniques for rehabilitating flexible pavements with surface course imperfections. Each delivers a piece of the road-renewal dream, leaving in the wake of its recycling train a smooth, flat surface that is accomplished relatively quickly and inexpensively.

In recent years, another recycling technology has gained popularity in North America — full-depth reclamation. It comes even closer to the road-renewal dream because it gives pavement managers a fast, inexpensive, long-wearing alternative to rebuilding roads that require major repairs or total reconstruction.

Traditional applications for full-depth reclamation include rural roads and city streets. Today, however, even major highways and interstates are being reclaimed by FDR.

While the other recycling technologies grind off a portion of the surface course of asphalt and replace it, full-depth reclamation penetrates the entire flexible pavement section and a predetermined portion of the base material, uniformly pulverizing and blending them together to produce a stabilized base course. Thus, FDR can correct deficiencies in the base as well as the bound asphalt layers.

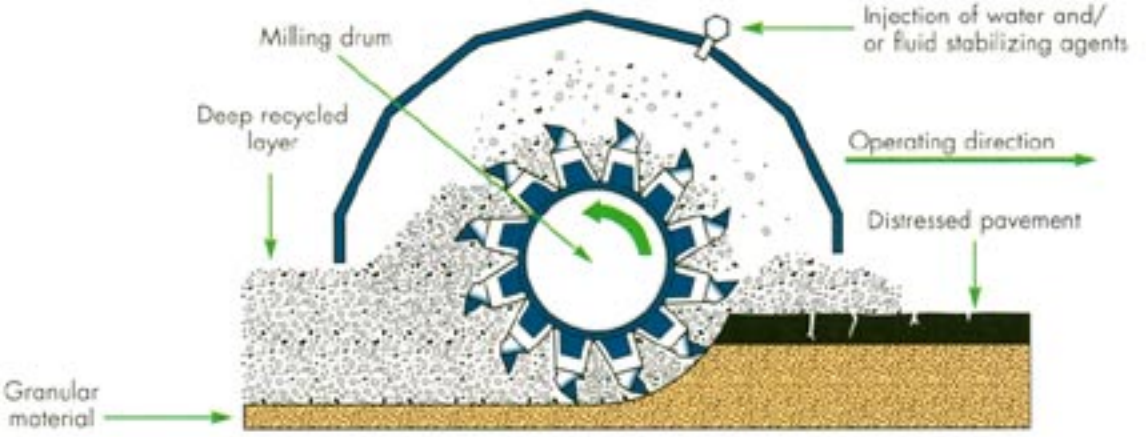
Full-depth reclamation technology can be utilized to depths of 12 inches or more; the most typical applications involve depths of 6 to 9 inches. As it pulverizes and mixes, the road reclaimer can also meter in precise amounts of additives to further enhance the structural characteristics of the stabilized base course. Its benefits start with the fact that FDR completely erases deep pavement cracks, eliminating the potential for reflective cracking. It also allows for cross-slope and profile grade adjustments, and road widening is easily accomplished.

The Evolution

At the heart of full-depth reclamation is a small fleet of road reclaimers, machines that use milling drums similar to those found on milling machines, but which are designed to cut and mix at much greater depths. Road reclaimers evolved from machines designed to handle mass production soil stabilization work. Indeed, the only difference between many of today's reclaimers and soil stabilizers is the milling drum.

These machines have been in use in Europe and in North America for many years, but their suitability for FDR, North American style, has evolved with the advent of high-horsepower diesel engines. Powered by engines as big as 800 horsepower, today's reclaimers cut harder and deeper, mix faster, and cover more ground than ever before. And with these im-

FDR'S PULVERIZATION AND MIXING PROCESS



provements, popular FDR applications have broadened from low volume country roads to include city streets and medium volume roadways.

The classic application for FDR is a secondary or tertiary road with a 2- to 4-inch asphalt overlay on a compacted base. When the overlay is too deeply cracked or rutted for a mill-and-fill remedy, full-depth reclamation is the next cheapest alternative — and it can produce a much longer-lasting solution.

The full-depth reclamation process is fast and straightforward. A reclaimer pulverizes and mixes the asphalt and base material, creating a strong new base. The reclaimer is typically followed by a grader, a water truck, and various compactors. Minutes after the last compactor completes its pass, the road can usually be opened to traffic until the contractor is ready to apply the final surface treatment.

For some low-traffic roads, the surface treatment can be as simple as a double chip seal. For higher traffic roadways, the FDR operation is typically followed by an asphalt overlay, creating a new road that should have much better wear and load-bearing properties than the old road. More to the point, say FDR advocates, the new road is the equivalent of a traditionally rebuilt road in terms of life expectancy, wear, and load-bearing characteristics, but it costs a fraction as much and can be completed with far less interruption of traffic.

Full-depth reclamation can be used to rehabilitate and improve gravel roads, and it has also been used on major highways, including interstates. There have even been cases where a road was first milled, to reduce the bound asphalt depth to an appropriate thickness, so that FDR techniques could be applied. This milling is also sometimes done to allow for proper curb reveal on curb and gutter streets or to control grade prior to the subsequent asphalt overlay.

The full potential of full-depth reclamation is still being defined, but it has emerged as an important and valuable option for road managers to consider as they search for budget-stretching solutions to the thousands of miles of roads in Canada and the U.S. that can no longer be cost-effectively repaired.

Written by the editors of *Better Roads* in cooperation with the Asphalt Recycling and Reclaiming Association.

Full-depth reclamation is the only rehabilitation technique that completely eliminates the deep cracks that can cause premature reflective cracking in overlays.

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Rebuilding by Reclaiming– the FDR Process

An illustrated guide to the basic full-depth reclamation process

Like most road construction technologies, full- depth reclamation can be applied in many different forms, depending on the physical properties of the old road and the performance requirements for the new one. In most jobs, however, there are eight basic phases, from pulverization and moisture conditioning to the laying of the final surface course.

Full-depth reclamation starts with a road reclaiming machine pulverizing and mixing the old bituminous pavement layers and a predetermined amount of base or sub-base material. The size of the pulverized material is determined by the reclaimer's forward motion speed, cutting rotor speed, gradation control beam position, and the front and rear door position of the mixing chamber.

While the reclaimer is not a crushing machine and cannot reduce pavement to any size smaller than the original aggregate — or the stone in the base material — it does leave a homogenous, well-graded material in its wake. According to Caterpillar's Full Depth Reclamation handbook, on a typical job the reclaimer can be set up to leave a maximum particle size of two inches, with 95% of the material passing a 1.5-inch screen.

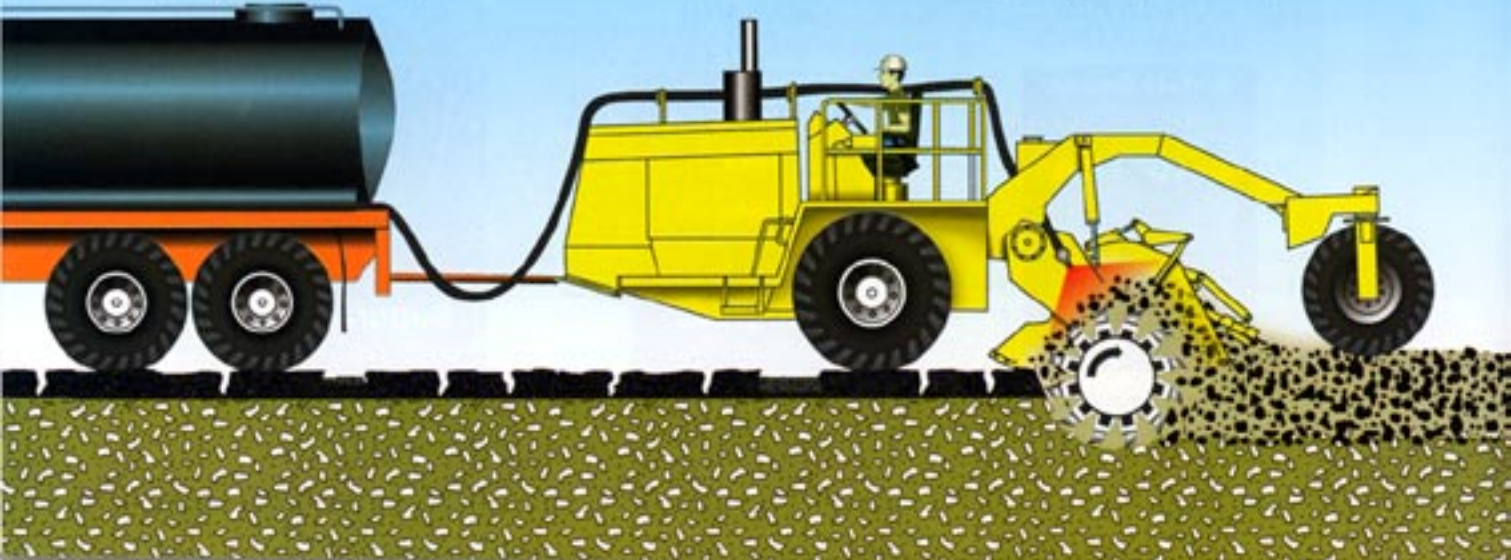
Moisture — usually water — is added during the pulverization process to achieve the required density of material. In some cases, the moisture is metered into the mix by the reclaimer's liquid additive system, though it can be sprayed directly on the surface after

Pulverization

A road reclaimer pulverizes in-situ pavement layers and blends asphalt material with a predetermined amount of underlying material. Additional materials and stabilization agents can be added during this process, usually requiring multiple passes by the reclaimer.

Moisture Conditioning

Moisture is added to the pulverized material to aid in compaction. Though moisture can be surface-added after pulverization, the preferred method is to use the reclaimer's integrated fluid injection systems which provide precise moisture conditioning during the pulverization process.



the reclaimer's first pass.

Just one reclamation pass is usually required in applications where the pavement is less than 6 inches thick, no stabilizing additives are required, and major geometric corrections are not needed.

Conversely, multiple passes are called for if one or more stabilizers are to be added, or if major grade or profile corrections are required. Multiple passes are sometimes used when the job involves pavements that are more than 6- inches thick, and when the pavement is being widened.

In a typical multiple-pass application, after the first reclamation pass the material is pre-shaped and compacted, then the stabilizing additives are applied and mixed in a second, blending pass. In some jobs requiring more than one stabilizer additive, a third pass may be required.

Breakdown compaction follows the last reclamation pass. The goal is to achieve a more consistent material density in the reclaimed layer prior to shaping with the motor grader. Depending upon the thickness and composition of the new base, the tools of choice range from a single-drum vibratory padfoot roller (at least 52,000 pounds, centrifugal force) to a 25-ton (minimum) pneumatic roller.

Shaping is the process in which a motor grader sculpts the mat's grade and cross slope. This is one of the important advantages of full-depth reclamation, since it allows major corrections to be made in older roads constructed under design parameters that may no longer be adequate for the usage they receive.

Road widening, another potential benefit of full-depth reclamation, can also be accomplished during shaping. In order to maintain sectional thickness, additional granular materials are usually required.

Intermediate compaction comes next. Again, depending upon the thickness and composition of the mat, this step uses either a pneumatic roller to knead the material or a heavy smooth-drum vibratory compactor to seat any loose aggregates left by the motor grader. The pneumatic roller is probably the more common choice, and some light shaping with a motor grader may be required after this pass.

Finish rolling is accomplished with a 12- to 14-ton single or double-drum roller operating in the static mode.

After the final compaction pass, the reclaimed road bed is sealed with an asphalt emulsion or some other specified sealer. This fog seal is applied to the surface to bind loose particles and protect the reclaimed layer against weather and traffic. The reclaimed layer can generally be open for traffic as soon as the seal coat dries.

Since the reclamation process converts the old pavement and part of the base into a new, structurally stronger base, the final step in a full-depth reclamation project is to place a new surface treatment on the improved base. Four surface treatments are the most common: double chip seal, single or double chip cape seal, cold-mix overlay, or hot-mix overlay.

Asphalt-treated reclaimed material makes an especially strong base and that can make it possible to use a less expensive surface treatment and achieve the same or better economical life than would be possible with any other repair alternative. In some cases, this might mean using one of the chip and seal treatments instead of asphalt; in others, it might mean using thinner layers of asphalt.

Structural Strength

Many variable factors contribute to the structural strength coefficient for pavements, bases and subbases, so calculating the advantages of an FDR base needs to be done on a project-specific basis. Still, a series of examples published in Caterpillar's *Full Depth Reclamation Handbook* illustrates how dramatic the FDR advantage can be.

Breakdown Compaction

Breakdown compaction immediately follows the reclaimer to achieve consistent material density in the reclaimed mat prior to any shaping with the motor grader.

Shaping

Grade and cross-slope adjustments are made by a motor grader after breakdown compaction. Widening can also be accomplished at this point, though it may require multiple reclaimer passes if extra stone or RAP is added in the pulverizing process.

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In these examples, three different rehabilitation techniques are examined for a 15-year-old road with a surface of 5 inches of deteriorated hot mix asphalt, a base of 6 inches of decompacted (due to age) stone, and a sub-base of 8 inches of decompacted sand and gravel. Its structural number is 1.44, well below is terminal serviceability level of 2.00.

In example one, by simply adding a 3-inch hot-mix asphalt overlay, the road's structural number increases to just 2.85 — only a little over its terminal serviceability level.

The second alternative is reconstruction — the removal of the old asphalt surface course, reshaping and recompacting the crushed stone base, then applying a 5-inch hot-mix asphalt overlay. This treatment, far more expensive, produces a structural number of 3.50.

Full-depth reclamation is the third alternative. In this example, the road is reclaimed to a depth of 8 inches and stabilized with asphalt emulsion. The asphalt-treated base then receives a 3-inch asphalt overlay. Because the asphalt-treated base has a much higher structural coefficient than either of the crushed stone bases in the other examples, the reclaimed road has a significantly higher overall structural number — 4.01 — than either of the other two alternatives.

Other Benefits

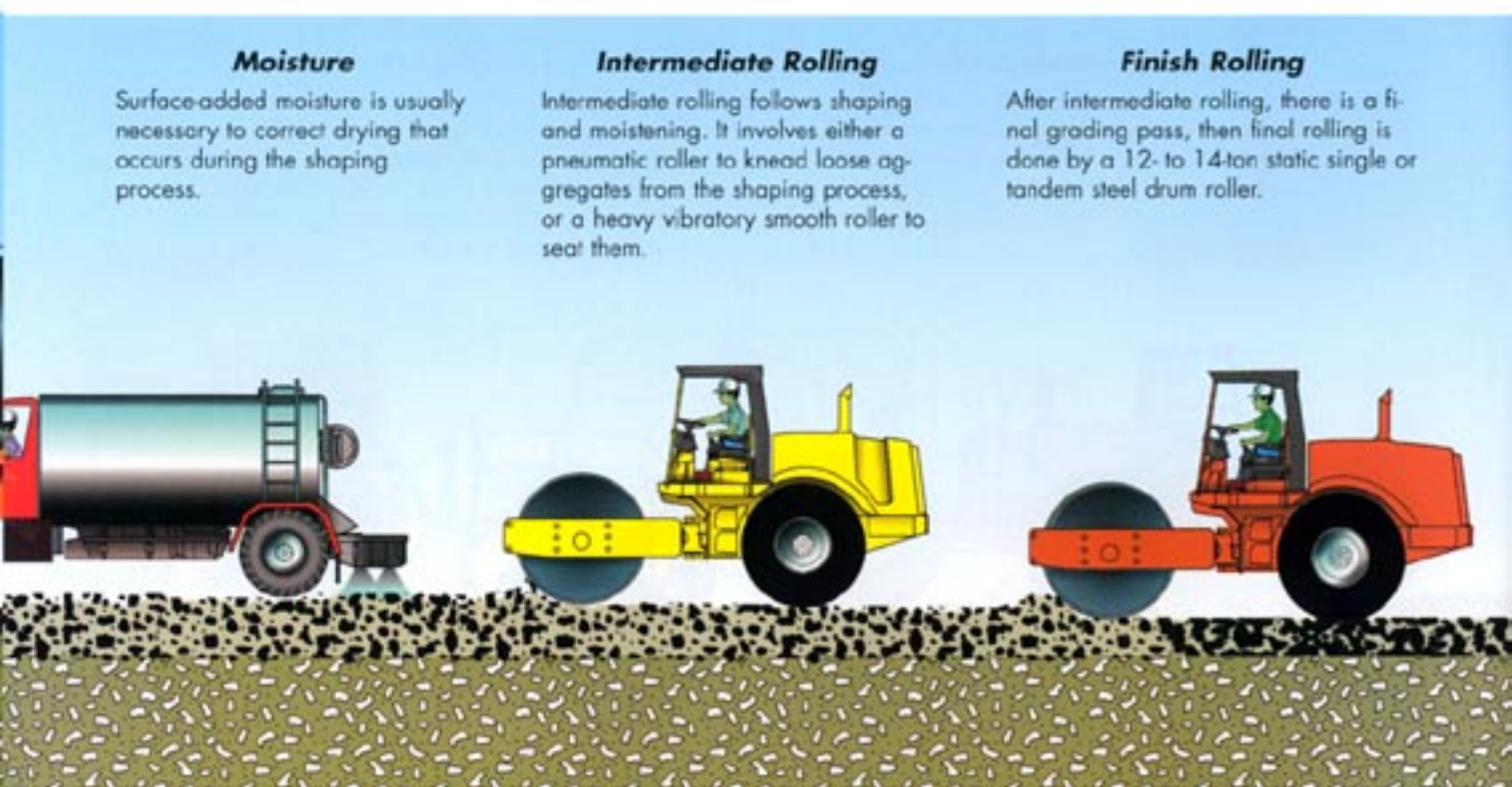
In addition to its structural advantages, full-depth reclamation costs substantially less than reconstruction — 40 to 60% less, according to FDR contractors and their customers.

That economy is the product of several FDR benefits, starting with the fact that this is a recycling technology, so most of the materials used are already present in the old roadway. The improved base makes it possible to economize on the surface treatment without sacrificing engineering integrity. And full-depth reclamation can generally cover more lane miles in less time than reconstruction.

How fast can FDR advance? Production rates can vary from a few hundred yards per day to more than a mile of two-lane highway per day. The main variables: composition of the old pavement, depth of material, gradation requirements, and the number and type of additives required. Production rates of a half-mile to a mile of two-lane road per day are not unusual.

Applying FDR

Full-depth reclamation is the management alternative for pavements that are too distressed to be good candidates for simple overlay or mill-and-fill solutions. Major indicators include frequent deep crack-



ing, reflective cracking in overlays, heavy pothole patching, severe rutting, frost heaves, parabolic shape, and insufficient base strength.

Other recycling techniques can be used to address some of these maladies at a lower up-front cost, but the more the pavement has degenerated, the more likely it is that full-depth reclamation will provide the lowest-cost solution over a period of years.

As a case in point, severely cracked pavement — where the cracks penetrate all the way to the base — can be milled and overlaid for less cost than an FDR treatment. However, since the overlay rests on top of cracked pavement, it will be prone to reflective cracking in a few years. Full-depth reclamation should provide a much longer lasting solution because it eliminates the cracking and creates a new, stronger base for the new surface treatment.

Today, full-depth reclamation is being widely used on city streets and state highways, as well as secondary roads. It is also being specified for some interstate highway applications. Beyond road applications, FDR is used for private and regional airport pavements, and for parking lots.

Written by the editors of *Better Roads* in cooperation with the Asphalt Recycling and Reclaiming Association.

Comparing Road Repair Alternatives

These tables of hypothetical structural coefficients for three approaches to repairing a deteriorated road reflect the kind of cost-efficiency advantages available through full-depth reclamation.

Overlay Alternative

Layer	Coefficient	Depth
New Hot-Mix Asphalt	0.42	3"
Deteriorated HMA	0.15	5"
Decompacted Crushed Stone Base	0.06	6"
Decompacted Sand & Gravel	0.06	8"

Structural Number: 2.85

Reconstruction Alternative

Layer	Coefficient	Depth
New Hot-Mix Asphalt	0.42	5"
Reconstructed Crushed Stone Base	0.14	6"
Decompacted Sand & Gravel	0.07	8"

Structural Number: 3.50

Reclamation Alternative

Layer	Coefficient	Depth
New Hot-Mix Asphalt	0.42	3"
Reclaimed HMA	0.25	8"
Decompacted Crushed Stone Base	0.09	3"
Decompacted Sand & Gravel	0.06	8"

Structural Number: 4.01

Sealant

A fog seal of asphalt emulsion or specified sealer is applied to the surface to bind any loose particles and protect the reclaimed layer against weather and traffic. The reclaimed layer can generally be open for traffic as soon as the seal coat dries.

New Surface Course

Reclamation is followed by a new surface course, ranging in cost from a double chip seal for low-traffic roads to hot-mix asphalt for roads with more demanding loads.

Illustration by Edd Hickingbottom.

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How to Build Better Bases With Stabilization

With the right stabilizing agents, old pavement can become the foundation for a long-lasting road

Most full-depth reclamation jobs involve the use of one or more stabilizing additives to enhance the strength or wear characteristics of the new base.

These additives fall into three general categories: mechanical, bituminous, and chemical.

Mechanical

Mechanical stabilization involves the addition of granular materials such as crushed aggregate, asphalt grindings, or crushed concrete.

Mechanical stabilization is used to improve the overall grade of the reclaimed material, thus improving structural stability. It can also be used to lean in-situ pavements with a high concentration of bitumen, which also enhances structural stability.

Granular materials are often added when job specifications call for a road to be widened or for corrections in profile grade or cross slope. In each case, the addition of mechanical stabilizers allow the reclaimed base to be reshaped without sacrificing section thickness.

Mechanical, bituminous and chemical additives can be used to enhance the strength and durability of reclaimed base materials in the FDR process.

Mechanical stabilizers can be spread by a combination of end-dump trailer and motor grader, or, for more precision, by mechanical spreaders or a paver. Although mechanical stabilizers can be added in the road reclaimer's first pass, it often requires a second pass. In the latter case, the additives are spread after the reclaimer's pulverizing pass, then mixed into the reclaimed material on the machine's second pass.

Bituminous

Bituminous stabilizing additives coat the particles of reclaimed material and bind them to one another, improving the strength of the reclaimed base while reducing the effects of moisture. These stabilizers have been used in full-depth reclamation for years and produce a reclaimed base that is more flexible than other base course materials, offers superior fatigue resistance, and resists cracking.

Emulsified asphalt is the most common family of bituminous additives. While there is a wide range of emulsified asphalt products, most consist of 60 to 65% asphalt cement and 35 to 40% water and emulsifier chemicals. Emulsified asphalt can be custom blended for specific applications and compositions of base materials. It has the advantage of working well with many sizes of materials.

Foamed/expanded asphalt is an alternative to emulsified asphalt. This technique involves joining hot asphalt with small amounts of water, setting off a thermal reaction in which the asphalt forms tiny foam bubbles. Since there is very little water involved in the process, the stabilized base material cures rapidly and has a wider temperature window for constructing than other stabilizers.

Both types of bituminous stabilizer work well in combination with other types of additives, such as granular materials, cement, or lime.

According to the Asphalt Recycling and Reclaim-

A motor grader spreads aggregate on a country road prior to a road reclaimer's mixing.

ing Association, bituminous stabilization is best suited for aged, oxidized, overloaded pavements that are subject to medium to high traffic volume.

Chemical

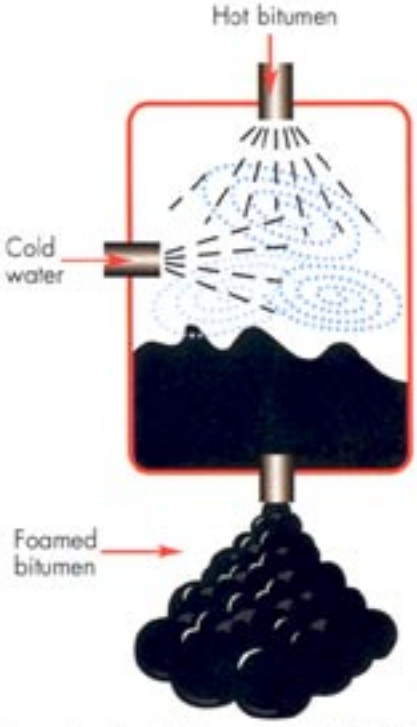
Chemical stabilization additives like Portland cement, lime, and fly ash are used to add strength by cementing particles and aggregates in the reclaimed layer.

Laboratory testing is needed to determine the type and amount of chemical stabilizers to be used, based on the type of reclaimed material being stabilized and the performance expected of the new base. If the amount of chemical additive is too high, the material can develop strengths that reduce its flexibility, which can reduce its ability to withstand repeated loading.

These additives can be spread ahead of the reclaiming machine in a powder form with calibrated spreading units, or they can be disbursed in slurry form, either on the ground in front of the reclaimer or through the reclaimer's integral fluid injection system.

According to ARRA, stabilizers like Portland cement, lime, and fly ash are best suited for pavements showing severe distress from heavy wheel loads on base, sub-base or sub-grade materials with insufficient strength. For pavements with high traffic volumes, the stabilized material is typically used as a sub-base; for low to medium volume pavements, the stabilized material can be used as a base course.

Foamed Asphalt Expansion Chamber



Foamed asphalt is the product of hot bitumen meeting small amounts of cold water, creating thin bubbles of bitumen to bond with pulverized base materials.

Calcium chloride is an additive used to lower the reclaimed layer's freeze/thaw point. This enhances the road's life expectancy by reducing frost heaving in the base layer — sometimes by as much as 40 to 50%.

Calcium chloride is best suited for pavements with low to medium traffic volume, according to the ARRA. It is relatively inexpensive compared to other additives and has moisture-retaining qualities which strengthen the base by aiding in compaction.

Stabilizing additives add to the cost and the time of full-depth reclamation projects, but they also add tremendous value by creating an improved base that leads to a longer lasting, more cost-effective road.

Written by the editors of *Better Roads* in cooperation with the Asphalt Recycling and Reclaiming Association.

Chemical stabilization additives are spread either in a slurry form or as a dry powder, then mixed into the base material by the reclaimer.

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Where to find answers to your...

Recycling & Reclaiming

...questions

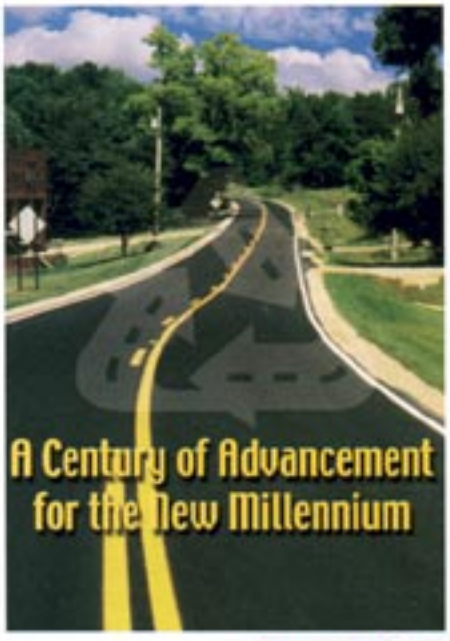
Introducing the Asphalt Recycling and Reclaiming Association and its growing library of resources

Everyone likes to talk about recycling, but there are 75 or so contractors and just over 30 suppliers who have made a commitment to refining the technology and communicating its benefits to highway professionals everywhere.

That is the core group that makes up the Asphalt Recycling and Reclaiming Association. They are supported by another small group of affiliate and honorary members, ranging from government agencies to other associations and magazines.

The activist members of ARRA have literally written the book on reclaiming and recycling in North America. Earlier this year, the group released its 24-page *Full-Depth Reclamation Manual*, the most authoritative publication on the subject now available. A collaboration between the contractor and supplier members of ARRA's Full-Depth Reclamation Committee, that work is the foundation for this supplement.

This summer, the association will publish its grandest venture to date, the *Basic Asphalt Recycling Manual*. This definitive reference work explains each recycling discipline in great detail and gives expert advice on which technology best fits various pavement conditions, usage patterns, and performance criteria.



Along with a growing library of publications, ARRA members conduct seminars for local organizations, universities, government agencies, and technology transfer centers many times each year. And members answer dozens of technical inquiries that come through association headquarters.

The association's Web site is an easily accessible source of recycling information. It lists contact information for all members, including e-mail addresses and Web sites. It also answers frequently asked questions about each recycling technology, and allows visitors to directly contact executive director Michael Krissoff or contractors in their area.

Contact ARRA

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You can also link to the ARRA Web site from the Association section of *www.BetterRoads.com* or request more information about ARRA by using the *Better Roads* reader service card.

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2001 BETTER ROADS

North America's Road Reclaimers Take a Power Trip:

Bigger, more powerful engines have opened up vast new horizons for today's road reclaimers

by Kirk Landers

Although there are tens of thousands of miles of North American roads that are good candidates for full-depth reclamation, just a handful of companies manufacture the machines that make the process possible.

Bomag, Caterpillar, CMI, Wirtgen, and Hamm, a Wirtgen division, supply the market's current combined total of 12 road reclaimer models.

Building road reclaimers is not for the uncommitted, and neither is buying them. The annual production volumes are small, measured in the dozens, not hundreds, per model. The machines are large — the average reclaimer weighs around 50,000 pounds and is powered by a 500-horsepower diesel engine. And the machines incorporate enough sophisticated technology to be fairly expensive — transaction prices range from around $200,000 to upwards of $500,000, depending on model size and options.

Bomag's rear-mounted-rotor design now features a 450-horsepower Cummins engine, a 90-horsepower increase over the previous MPH 100 models.

Contractors and manufacturers alike agree that the greatest technological breakthrough in recyclers over the past decade or so has been the advent of bigger, higher-horsepower engines. Six of today's models come with engines of 500 to 800 gross horsepower, and a seventh, Bomag's redesigned MPH454, has just upgraded to 450 horsepower.

The power surge has greatly expanded the range of pavement thickness and hardness that reclaimers can handle, not to mention their production rates.

All of the road reclaimers being offered today use hydrostatic drive and have automatic systems for adjusting travel speeds to the application and material being processed. Most have four wheel-drive for handling steep grades and severe traction conditions. Four-wheel steer is also common because it enhances the machine's ability to precisely carve through curves and corners.

The heart of the reclaimer is its pulverizing and mixing drum, or rotor, and the related apparatus. Most of the current models employ a mechanical drive system to turn the rotor. While mechanical drive can require more maintenance than hydrostatic, it delivers more power to the rotor. Multiple rotor speeds are the rule, allowing the operator to adjust to difficult or easy conditions.

Conventional reclaimer design places the pulverizing rotor and chamber in a center-mount position, between the front and rear wheels of the machine. Bomag's MPH454 and MPH362/364, and CMI's RS325 offer the alternative of a rear-mounted rotor; the main advantages to this format are the ability to reach close to walls and barriers, and to crosscut materials.

Road Reclaimer Models/North America — July, 2001

Model — Cutter Location	Engine	Weight	Max. Cutting Depth	Cutting Width	Length	Width	Drive System	Rotor Drive: Speeds in rpm	Turning Radius (inside)
CMI RS325 – rear-mount	330 hp Cummins	31,200 lb	16"	75"	23'11"	8'1"	Hydrostatic 4wd, 4ws	Hydrostatic: 120, 175 rpm	7'0"
Cat RM-250C – center-mount	335 hp Cat 3406C	41,435 lb	13"-15"	96"	28'10"	9'7"	Hydrostatic 2wd, 4ws	Mechanical: 124, 168, 284 rpm	18'0"
Bomag MPH362 & 364 – rear-mount	360 hp Cummins	39,000 lb	12"-21"	79"	27'7"	9'7"	Hydrostatic 2wd (362), 4wd (364)	Hydrostatic: 135, 150 rpm	21'0"
CMI RS 425 – center-mount	435 hp Cat 3406	51,000 lb	16"	96"	30'7"	9'10"	Hydrostatic 4wd, 4ws	Mechanical: 108, 151, 209 rpm	19'0"
CMI RS450 – center-mount	435 hp Cat 3406	48,000 lb	14-16"	96"	23'5"	9'10"	Hydrostatic 4wd, 4ws	Mechanical: 110, 151, 209 rpm	18'0"
Bomag MPH454R – rear-mount	450 hp Cummins	46,300 lb	15"	96"	27'7"	10'1"	Hydrostatic 4wd	Hydrostatic: 135, 150, 165 rpm	21'0"
Cat RM-350B – center-mount	500 hp Cat 3406Ct	53,000 lb	18"-20"	96"	31'6"	9'10"	Hydrostatic 4ws; 4wd opt.	Mechanical: 115, 160, 215 rpm	18'0"
Hamm-Raco 350 – center-mount	503 hp Deutz BF8M	46,300 lb	18"	96"	31'4"	9'10"	Hydrostatic, AWD opt.	Hydrostatic: 120-145 rpm	10'10"
CMI RS500B – center-mount	525 hp Cat 3408	56,000 lb	16"	96"	25'8"	9'10"	Hydrostatic 4wd, 4ws	Mechanical: 86, 112, 137, 169 rpm	14'6"
Wirtgen WR 2500 – center-mount	601 hp Mercedes-Benz	69,900 lb	20"	96"	27'2"	9'10"	Hydrostatic 4wd, 4ws	Mechanical 4-speed	14'9"
CMI RS650 – center-mount	650 hp Cat 3412	65,000 lb	16"	96"	26'8"	9'10"	Hydrostatic 4wd, 4ws	Mechanical: 101, 130, 160, 198 rpm	14'6"
CMI RS800 – center-mount	800 hp Cat 3412E	72,000 lb	16"	120"	26'8"	9'10"	Hydrostatic 4wd, 4ws	Mechanical: 86, 112, 137, 169 rpm	14'6"

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Most of today's reclaimers feature 8-foot-wide rotors that pulverize and blend asphalt pavement and base by means of cutting tools mounted on the rotor's surface. The number of cutting tools, their pattern, and the mountings in which they are set vary from one manufacturer to another. In some cases, they also vary according to the intended application of the machine, with one design for soil stabilization, and another for pavement reclamation, and still another for performing both types of work. Though most FDR projects involve depths of 6 to 12 inches, all reclaimers on today's market can go much deeper; the range is from 13 to 21 inches.

The cutting tools themselves are available in a variety of designs and metallurgies from several different specialty suppliers.

Rotor-drum chamber design is another area of differentiation between manufacturers, as each takes a different approach to providing enough capacity for deep mixing while also ensuring uniform sizing.

Liquid additive systems and water spray systems are options on all models, allowing the buyer to specify a machine for specific types of applications. Systems for metering in precise amounts of fluid stabilizers or combinations of stabilizers can be very sophisticated-and expensive.

Though the road reclaimer market is still relatively small, there has been a lot of new product and product improvement activity in recent months. This calendar year has already seen three major announcements — CMI's introduction of the compact RS-325 in January, and Bomag's unveiling of the new generation MPH454R and its new MPH362/ 364 series in recent months. Still to come is the re-introduction of the Hamm/Raco 350, which is getting an infusion of Wirtgen rotor, tooth and pump technology.

Usage of road reclaimers has been trending upwards in North America for the past half-decade as acceptance of full-depth reclamation has grown. The technology is well established in many Canadian provinces and is gaining recognition in an increasing number of American states. As the demand for full depth reclamation work continues to cycle upward over the next decade, road reclaimer technology will probably continue to evolve in the direction defined by this year's product changes — new models on the large and small end of the market, increasing the range of potential applications, and constant incremental gains in the efficiency of machines in the established size niches.

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Road Reclaimer Model Guide

A model-by-model review of current machine offerings

Bomag MPH454R

An all-new rear-mounted-rotor machine

Bomag has dramatically upgraded its reclaimer offering with the new MPH454R. The rear-mounted-rotor design now features a 450-horsepower Cummins engine, a 90-horsepower increase over the previous MPH 100 models. The extra power goes for increased travel speed, a wider rotor, and increased cutting depth. The MPH454R uses hydrostatic drive to power its rotor drum, and Bomag claims its unique relief system increases shock absorption and reduces the possibility of damage to the equipment. The new machine is also said to have improved electronic control systems, including single-lever control for travel and steer-assist braking.

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Caterpillar RR-250C

A lighter machine with production features

In terms of weight and horsepower, Cat's RR-250C is one of the smaller machines on the market, but it drives a full-width, 96-inch rotor and is designed to handle a variety of small projects, from parking lots to municipal streets. The center-mount unit has a maximum cutting depth of 13 to 15 inches, depending on which rotor drum is used. It has hydrostatic 2-wheel drive, 4-wheel steering and 3-speed mechanical rotor drive.

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CMI RS-500B, RS-650 and RS-800

Production machines for highway and airport applications

CMI offers three production models for big project applications. The three share the same basic platform and offer increasing degrees of productivity based on engine power. All feature 4-wheel hydrostatic drive, 4-wheel-steer, forward and reverse operating modes, and mechanical rotor drive. The 525-horsepower RS-500B and the 650-horsepower RS-650 have 96-inch-wide cutting drums and weigh 56,000 and 65,000 pounds, respectively. The 800-horsepower RS-800, introduced in 1999, weighs 72,000 pounds and comes with a 120-inch-wide rotor.

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Wirtgen WR 2500

Production machine for soil or pavement

Wirtgen's 600-horsepower, 70,000-pound WR 2500 employs the same drum for both asphalt reclamation and soil stabilization, saving changeover time and capital investment. The machine features hydrostatic 4-wheel drive, 4-wheel steer, and mechanical rotor drive. It is one of the few machines on the market that has a 20-inch maximum cutting depth. The company has recently announced the availability of a "K" version of the machine that has an integrated hopper for precisely metering out powdered additives like lime or cement immediately in front of the rotor. Wirtgen says this prevents windblown losses of material and complaints about clouds of additive dust when working in residential areas.

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Bomag 362 & 364

The market's two newest models

Bomag introduced the all new MPH362 and 364 this spring, the newest models on the market. The MPH362 is a rear-wheel-drive unit, while the 364 has 4-wheel-drive. The two utility-size models feature rear-mount rotors and weigh 39,000 pounds. A 360-horsepower engine powers hydrostatic drives for forward travel and for the recycling rotor. The rotor drive uses Bomag's relief system for shock absorption. Three different rotors are available: a reclaiming model with a 12-inch maximum cutting depth, a 14-inch soil stabilizing design, and a 21-inch deep-mix design. All three rotors are 79-inches wide.

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Caterpillar RM-350B

A 500-horsepower production machine

Cat's production class reclaimer is the 53,000-pound, 500-horsepower RM-350B. Its hydrostatic propel system has a 2-speed front transaxle and a 2-speed hydrostatic motor; 4-wheel drive is optional. The mechanically driven cutting drum has a maximum cutting depth of 18 inches with a combination reclamation/stabilization rotor, or 13 inches with a specialty reclamation rotor. A micro processor monitors and controls major machine functions.

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CMI RS-325

A new compact rear-mount for tight places

CMI's new RS-325 is a beefed up version of the Barco 275, but it is still the lightest and most compact model in the road reclaimer market. The RS-325 is designed for municipalities and contractors who often need to work around obstructions such as manholes and drainboxes. The rear-mounted cutter also allows the machine to work close to walls and barriers. The machine's compact, 75-inch cutter and 31,200-pound weight — nearly 10,000 pounds lighter than any other model — allow it to be powered by a fuel-efficient 330-horsepower Cummins diesel. Hydrostatic drive is used both for forward travel and for powering the cutting and mixing drum. Other features include 4-wheel drive, 4-wheel steer and a maximum cutting depth of 16 inches.

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Hamm/Raco 350

A tight-turning, all hydrostatic alternative

Wirtgen, which acquired Hamm last year, plans to continue producing the Hamm/Raco 350, but with a number of modifications. The 503-horsepower, 46,000-pound machine offers an alternative to the bigger, more powerful Wirtgen WR 2500. It is the only center-mounted design with hydrostatic rotor drive and its articulated chassis and rear wheel steering produce the tightest turning radius of its class. The unit uses a hydrostatic propel system; 4-wheel drive is an option.

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CMI RS-425 and RS-450

Two mid-size machines for the public works market

CMI's RS-425 and its compact stable mate, the RS-450, are designed for what CMI calls the industrial and public works markets. At 435 horsepower and roughly 50,000 pounds in weight, the two can handle a wide range of potential applications. Both feature center-mounted, detachable mixer assemblies, bi-directional operation, hydrostatic 4-wheel-drive, 4-wheel-steer, and mechanical rotor drives. The RS-450 is the newer model, introduced in 1998 to provide a shorter, narrow-turning alternative to the established RS-425. The RS-450 is 7 feet shorter overall and its turning radius is a full 12 inches tighter.

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